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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 09/841,305  
Filing Date: April 24, 2001  
Inventors: Wellington et al.  
Title: IN SITU THERMAL  
PROCESSING OF A  
HYDROCARBON  
CONTAINING FORMATION  
WITH A SELECTED  
MOISTURE CONTENT

§ Examiner: J. J. Kreck  
§ Group/Art Unit: 3673  
§ Atty. Dkt. No.: 5659-02200/EBM

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CERTIFICATE OF MAILING  
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I hereby certify that this correspondence is being deposited with  
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Commissioner for Patents  
Washington, DC 20231  
Jackie L. Pitre

AMENDMENT; RESPONSE TO OFFICE ACTION MAILED JUNE 25, 2002

Commissioner for Patents  
Washington, D.C. 20231

Sir:

Please amend the above-captioned application as follows:

In the Specification:

Listed below is a clean copy of amended paragraphs of the specification. A marked-up copy indicating the amended paragraphs of the specification is provided in an accompanying document.

On page 38, please delete the paragraph beginning on line 14 and substitute therefor:

As used herein, "a method of treating a hydrocarbon containing formation" may be used interchangeably with "an in situ conversion process for hydrocarbons." "Hydrocarbons" are

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generally defined as molecules formed primarily by carbon and hydrogen atoms. Hydrocarbons may also include other elements, such as, but not limited to, halogens, metallic elements, nitrogen, oxygen, and/or sulfur. Hydrocarbons may be, but are not limited to, kerogen, bitumen, pyrobitumen, and oils. Hydrocarbons may be located within or adjacent to mineral matrices within the earth. Matrices may include, but are not limited to, sedimentary rock, sands, silicilytes, carbonates, diatomites, and other porous media.

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On page 64, please delete the paragraph beginning on line 11 and substitute therefor:

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As shown in FIG. 3, in addition to heat sources 100, one or more production wells 104 will typically be disposed within the portion of the coal formation. Formation fluids may be produced through production well 104. Production well 104 may also include a heat source. In this manner, the formation fluids may be maintained at a selected temperature throughout production, thereby allowing more or all of the formation fluids to be produced as vapors. Therefore high temperature pumping of liquids from the production well may be reduced or substantially eliminated, which in turn decreases production costs. Providing heating at or through the production well tends to: (1) inhibit condensation and/or refluxing of production fluid when such production fluid is moving in the production well proximate to the overburden, (2) increase heat input into the formation, and/or (3) increase formation permeability at or proximate the production well.

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**In the Claims:**

Below is a clean copy of amended and new claims. A marked up copy of the amended claims is provided in an accompanying document.

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2039. (amended) A method of treating a hydrocarbon containing formation in situ, comprising:  
providing heat from one or more heaters to at least a portion of the formation;  
allowing the heat to transfer from the one or more heaters to a part of the formation;

Sub  
F1

wherein the part of the formation has been selected for heating using a moisture content in the part of the formation, and wherein at least a portion of the part of the formation comprises a moisture content of less than about 15%; and  
producing a mixture from the formation.

Sub  
E1

2040. (amended) The method of claim 2039, wherein the one or more heaters comprise at least two heaters, and wherein superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons within the part of the formation from about 270 °C to about 400 °C.

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23

2041. (amended) The method of claim 2039, further comprising maintaining a temperature within the part of the formation within a pyrolysis temperature range from about 270 °C to about 400 °C.

2042. (amended) The method of claim 2039, wherein at least one of the one or more heaters comprises an electrical heater.

2043. (amended) The method of claim 2039, wherein at least one of the one or more heaters comprises a surface burner.

2044. (amended) The method of claim 2039, wherein at least one of the one or more heaters comprises a flameless distributed combustor.

2045. (amended) The method of claim 2039, wherein at least one of the one or more heaters comprises a natural distributed combustor.

2046. (amended) The method of claim 2039, further comprising controlling a pressure and a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

Sub E2  
2047. (amended) The method of claim 2039, further comprising controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day during pyrolysis within a pyrolysis temperature range from about 270 °C to about 400 °C.

2048. (amended) The method of claim 2039, wherein providing heat from the one or more heaters to at least the portion of formation comprises:

heating a selected volume ( $V$ ) of the hydrocarbon containing formation from the one or more heaters, wherein the formation has an average heat capacity ( $C_v$ ), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day ( $P_{wr}$ ) provided to the selected volume is equal to or less than  $h \cdot V \cdot C_v \cdot \rho_B$ , wherein  $\rho_B$  is an average formation bulk density, and wherein an average heating rate ( $h$ ) of the selected volume is less than about 10 °C/day.

Sub E3  
2050. (amended) The method of claim 2039, wherein providing heat from the one or more heaters comprises heating the part of the formation such that a thermal conductivity of at least a portion of the part of the formation is greater than about 0.5 W/(m °C).

Sub E4  
2062. (amended) The method of claim 2039, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

Sub F1  
2065. (amended) The method of claim 2039, further comprising controlling a pressure within at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 bar absolute.

Sub F2  
2070. (amended) The method of claim 2039, further comprising:  
providing hydrogen ( $H_2$ ) to the heated part of the formation to hydrogenate hydrocarbons within the part of the formation; and

C7  
heating a portion of the part of the formation with heat from hydrogenation.

Sub  
E3  
2072. (amended) The method of claim 2039, wherein allowing the heat to transfer comprises increasing a permeability of a majority of the part of the formation to greater than about 100 millidarcy.

2073. (amended) The method of claim 2039, wherein allowing the heat to transfer further comprises substantially uniformly increasing a permeability of a majority of the part of the formation.

Sub  
F1  
2075. (amended) The method of claim 2039, wherein producing the mixture comprises producing the mixture in a production well, and wherein at least about 7 heaters are disposed in the formation for each production well.

C9  
2076. (amended) The method of claim 2039, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, and wherein the unit of heaters comprises a triangular pattern.

2077. (amended) The method of claim 2039, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

2078. (amended) A method of treating a hydrocarbon containing formation in situ, comprising:  
providing heat from one or more heaters to a part of the formation;  
allowing the heat to transfer from the one or more heaters to the part of the formation;  
wherein at least a portion of the part of the formation has an initial moisture content of less than about 15%, and

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F1  
✓  
producing a mixture from the formation.

2079. (amended) The method of claim 2078, wherein the one or more heaters comprise at least two heaters, and wherein superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons within the part of the formation.

2080. (amended) The method of claim 2078, further comprising maintaining a temperature within the part of the formation within a pyrolysis temperature range from about 270 °C to about 400 °C.

2081. (amended) The method of claim 2078, wherein at least one of the one or more heaters comprises an electrical heater.

2082. (amended) The method of claim 2078, wherein at least one of the one or more heaters comprises a surface burner.

2083. (amended) The method of claim 2078, wherein at least one of the one or more heaters comprises a flameless distributed combustor.

2084. (amended) The method of claim 2078, wherein at least one of the one or more heaters comprises a natural distributed combustor.

2085. (amended) The method of claim 2078, further comprising controlling a pressure and a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

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E6  
✓  
2086. (amended) The method of claim 2078, further comprising controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day during pyrolysis within a pyrolysis rang of about 270 °C to about 400 °C.

2087. (amended) The method of claim 2078, wherein providing heat from the one or more heaters to at least the portion of formation comprises:

heating a selected volume ( $V$ ) of the hydrocarbon containing formation from the one or more heaters, wherein the formation has an average heat capacity ( $C_v$ ), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day ( $P_{wr}$ ) provided to the selected volume is equal to or less than  $h \cdot V \cdot C_v \cdot \rho_B$ , wherein  $\rho_B$  is an average formation bulk density, and wherein an average heating rate ( $h$ ) of the selected volume is less than about 10 °C/day.

2089. (amended) The method of claim 2078, wherein providing heat from the one or more heaters comprises heating the part of the formation such that a thermal conductivity of at least a portion of the part of the formation is greater than about 0.5 W/(m °C).

2101. (amended) The method of claim 2078, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

2104. (amended) The method of claim 2078, further comprising controlling a pressure within at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 bar absolute.

2109. (amended) The method of claim 2078, further comprising:  
providing hydrogen ( $H_2$ ) to the heated part of the formation to hydrogenate hydrocarbons within the part of the formation; and  
heating a portion of the part of the formation with heat from hydrogenation.

Sub E9  
C15  
2111. (amended) The method of claim 2078, wherein allowing the heat to transfer comprises increasing a permeability of a majority of the part of the formation to greater than about 100 millidarcy.

2112. (amended) The method of claim 2078, wherein allowing the heat to transfer further comprises substantially uniformly increasing a permeability of a majority of the part of the formation.

Sub F1  
C16  
2114. (amended) The method of claim 2078, wherein producing the mixture comprises producing the mixture in a production well, and wherein at least about 7 heaters are disposed in the formation for each production well.

2115. (amended) The method of claim 2078, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, and wherein the unit of heaters comprises a triangular pattern.

2116. (amended) The method of claim 2078, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

Sub F1  
C17  
5396. (amended) The method of claim 2039, wherein producing the mixture comprises producing the mixture in a production well and wherein at least about 20 heaters are disposed in the formation for each production well.

5397. (amended) The method of claim 2078, wherein producing the mixture comprises producing the mixture in a production well and wherein at least about 20 heaters are disposed in the formation for each production well.



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E10

5398. (new) A method of treating a hydrocarbon containing formation in situ, comprising:  
evaluating a moisture content of hydrocarbon containing material in the hydrocarbon containing formation to identify a portion of the hydrocarbon containing material with an moisture content that is less than about 20%,  
providing heat from one or more heaters to the portion to raise temperature in the portion so that an average temperature in the portion is above a temperature sufficient to pyrolyze hydrocarbon containing material in the portion; and  
producing a mixture from the formation.

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F1  
C18

5399. (new) The method of claim 5398, further comprising controlling a pressure and temperature within at least a majority of the portion, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

5400. (new) The method of claim 5398, wherein providing heat from one or more heaters to the portion comprises providing heat to a portion of the hydrocarbon containing material identified as having a moisture content that is less than about 15%.

5401. (new) The method of claim 5398, wherein providing heat from one or more heaters to the portion comprises providing heat to a portion of the hydrocarbon containing material identified as having a moisture content that is less than about 10%.

5402. (new) The method of claim 5398, wherein producing the mixture comprises producing the mixture in a production well, and wherein at least about 7 heaters are disposed in the formation for each production well.

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E11

5403. (new) The method of claim 5398, wherein providing heat from the one or more heaters to at least the portion of formation comprises:

Ex Sub E11

heating a selected volume ( $V$ ) of the hydrocarbon containing formation from the one or more heaters, wherein the formation has an average heat capacity ( $C_v$ ), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day ( $P_{wr}$ ) provided to the selected volume is equal to or less than  $h \cdot V \cdot C_v \cdot \rho_B$ , wherein  $\rho_B$  is an average formation bulk density, and wherein an average heating rate ( $h$ ) of the selected volume is less than about 10 °C/day.

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**Response to Office Action Mailed June 25, 2002**

**A. Pending Claims**

Claims 2039-2116 and 5396-5403 are pending. Claims 2039-2048, 2050, 2062, 2065 2070, 2072-2073, 2075-2087, 2089, 2101, 2104, 2109, 2111-2112, 2114-2116, 5396 and 5397 have been amended. Claims 5398-5403 are new.

**B. Submission of Corrected Formal Drawings**

In the Office Action mailed June 25, 2002, the Examiner indicated approval of the proposed drawing corrections filed on February 26, 2002. Applicant submits the corrected formal drawings approved by the Examiner.

**C. Signed Information Disclosure Statements**

In reviewing the returned PTO 1449 forms, Applicant noticed that pages 6 and 7 of references A1-A256 and B1 was not returned. Applicant respectfully requests a signed copy of pages 6 and 7 of the references, which include references A149 through A205. A copy of page 6 and 7 are enclosed for the convenience of the Examiner.

**D. Provisional Double Patenting Rejection**

The Examiner provisionally rejected claims 2039-2116, 5396 and 5397 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims of copending U.S. Patent Application Nos.:

09/840,936; 09/840,937, 09/841,000; 09/841,060; 09/841,061; 09/841,127;  
09/841,128; 09/841,129; 09/841,130; 09/841,131; 09/841,170; 09/841,193;  
09/841,194; 09/841,195; 09/841,238; 09/841,239; 09/841,240; 09/841,283;  
09/841,284; 09/841,285; 09/841,286; 09/841,287; 09/841,288; 09/841,289;  
09/841,290; 09/841,291; 09/841,292; 09/841,293; 09/841,294; 09/841,295;  
09/841,296; 09/841,297; 09/841,298; 09/841,299; 09/841,300; 09/841,301;  
09/841,302; 09/841,303; 09/841,304; 09/841,306; 09/841,307; 09/841,308;  
09/841,309; 09/841,310; 09/841,311; 09/841,312; 09/841,429; 09/841,430;  
09/841,431; 09/841,432; 09/841,433; 09/841,434; 09/841,435; 09/841,436;  
09/841,437; 09/841,438; 09/841,439; 09/841,440; 09/841,441; 09/841,442;  
09/841,443; 09/841,444; 09/841,445; 09/841,446; 09/841,447; 09/841,448;  
09/841,449; 09/841,488; 09/841,489; 09/841,490; 09/841,491; 09/841,492;  
09/841,493; 09/841,494; 09/841,495; 09/841,496; 09/841,497; 09/841,498;  
09/841,499; 09/841,500; 09/841,501; 09/841,502; 09/841,632; 09/841,633;  
09/841,634; 09/841,635; 09/841,636; 09/841,637; 09/841,638; and 09/841,639.

Applicant respectfully traverses the provisional double patenting rejection. Applicant respectfully submits that the omnibus nature of this rejection does not provide Applicant with sufficient detail in which to address such rejection. Applicant also respectfully submits that the rejection is also inconsistent with certain restrictions issued in the above-referenced cases. Applicant respectfully requests reconsideration.

Pursuant to the discussion in an Examiner interview on August 19, 2002, for the convenience of the Examiner, Applicant will forward copies of allowed claims for the above-referenced cases to the Examiner. Applicant understands that the Examiner will review the allowed claims for the above-referenced cases and then reconsider the double patenting rejection in view of such allowed claims.

**E. The Claims Are Definite Pursuant To 35 U.S.C. § 112, Second Paragraph**

Claims 2039-2116, 5396 and 5397 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Applicant believes the claims particularly point out and distinctly claim inventive subject matter. In addition, many of the rejected claims have been amended to clarify the claims. Applicant respectfully requests an explanation of particular deficiencies of the rejected claims or removal of the rejections.

The Examiner rejected claims 2075 and 2114 as being unclear regarding “at least about 7 heat sources.” The Examiner stated: “The modified “about” is not normally used in reference to an integer count (i.e., a number of sources); thus it is unclear what the scope of the claim is.” (Office Action, page 5).

The fact that claim language, including terms of degree, may not be precise, does not automatically render the claim indefinite under 35 U.S.C. 112, second paragraph. *Seattle Box Co., v. Industrial Crating & Packing, Inc.*, 731 F.2d 818, 221 U.S.P.Q. 568 (Fed. Cir. 1984).

Applicant submits that the number of heaters per well is a number of heaters per production well in a unit cell of the formation. Support for this interpretation is found at least in the paragraphs of the specification cited below.

The total number of heat sources 400 in unit cell 404 may include six full heat sources 400a that are each counted as one heat source, and six partial heat sources 400b that are each counted as one half of a heat source. Therefore, a ratio of heat sources 400 to production wells 402 in unit cell 404 may be determined as 9:1. A ratio of heat sources to production wells may vary, however, depending on, for example, the desired heating rate of the hydrocarbon containing formation, the heating rate of the heat sources, the type of heat source, the type of hydrocarbon containing formation, the composition of hydrocarbon containing formation, the desired composition of the produced fluid, and/or the desired production rate. Providing more heat sources wells per unit area will allow faster heating of the selected portion and thus hastening the onset of production,

however more heat sources will generally cost more money to install. An appropriate ratio of heat sources to production wells may also include ratios greater than about 5:1, and ratios greater than about 7:1. In some embodiments an appropriate ratio of heat sources to production wells may be about 10:1, 20:1, 50:1 or greater. If larger ratios are used, then project costs tend to decrease since less wells and equipment are needed.  
(Specification, page 72, lines 9-23).

In FIG. 58, production well 2701 and heat source 2712 may be located at the apices of a triangular grid. The triangular grid may be an equilateral triangular grid with sides of length,  $s$ . Production wells 2701 may be spaced at a distance of about  $1.732(s)$ . Production well 2701 may be disposed at a center of a hexagonal pattern with one ring 2713 of six heat sources 2712. Each heat source 2712 may provide substantially equal amounts of heat to three production wells. Therefore, each ring 2713 of six heat sources 2712 may contribute approximately two equivalent heat sources per production well 2701.  
(Specification, page 201, lines 11-18)

Thus, Applicant submits that “about 7 heaters” in amended claims 2075 and 2114 do not refer to an integer number of heaters, but rather to the effective number of heaters per production well.

The Examiner objected to Applicant’s definition of hydrocarbon. The Examiner states “While applicant may be his or her own lexicographer, a term in a claim may not be given a meaning repugnant to the usual meaning of the that term...Applicant’s vague definition of “hydrocarbon” is much broader than the accepted meaning of the term and this makes it impossible for one of ordinary skill in the art to ascertain the scope of the claims, which include the term “hydrocarbon”.” (Office Action pages 5 through 6). Applicant respectfully disagrees.

Applicant respectfully submits that Applicant has used an accepted meaning of the term “hydrocarbon” as defined by one of ordinary skill in the art. Support for this definition can be found in references within and associated with the art of the petroleum industry. For example, a reference within the art gives the following definition: “**Hydrocarbons:** molecules formed primarily by carbon and hydrogen atoms” (Hyne, N. J. *Geology for Petroleum Exploration, Drilling, and Production*, 1984, McGraw-Hill Book Company, pg. 264). The specification (page

38, paragraph beginning on line 14) has been amended for clarification. Applicant therefore respectfully requests removal of the rejection of Applicant's definition of the term "hydrocarbon."

The Examiner states "Claims 2048 and 2087 call for the heating energy to be equal to or less than Pwr. Pwr is defined using an ideal equation for heating. Since this equation fails to take into account the endothermic nature of pyrolysis reactions, and heat loss to adjacent formations; it is not clear how the heating energy can be equal to or less than Pwr." Applicant respectfully disagrees with the rejection. Applicant has amended the claims for clarification. Applicant submits that the amendments do not narrow the scope of the claims.

The Examiner rejected claim 2062 and 2101 as being unclear regarding "non-condensable component." Applicant respectfully disagrees with the rejection. Support for "non-condensable component" is found in Applicant's specification, which states,

Hydrocarbons in the produced fluids may include a mixture of a number of different components, some of which are condensable and some of which are not. The fraction of non-condensable hydrocarbons within the produced fluid may be altered and/or controlled by altering, controlling, and/or maintaining a temperature within a pyrolysis temperature range in a heated portion of the coal formation. Additionally, the fraction of non-condensable hydrocarbons within the produced fluids may be altered and/or controlled by altering, controlling, and/or maintaining a pressure within the heated portion. In some embodiments, surface facilities may be configured to separate condensable and non-condensable hydrocarbons of a produced fluid.  
(Specification, page 141, lines 6-14).

In addition, the Examiner rejected claim 2062 and 2101 as being unclear regarding a "benchmark temperature and pressure." Applicant has amended claims 2062 and 2101 to include conditions of 25 °C and one atmosphere absolute pressure, as described in the definition of "non-condensable hydrocarbons" on page 42, lines 13-14 of the specification.

Claims 2041 and 2080 were rejected as being unclear regarding "a pyrolysis temperature

range.” Applicant has amended claims 2041 and 2080 for clarification. Applicant submits that the amendment does not narrow the scope of the claim. Support for this amendment can be found in Applicant’s specification which states, “In an alternative embodiment, a pyrolysis temperature range may include temperatures between about 270 °C to about 400 °C.” (Specification, page 46, lines 14-15). Applicant submits that the amendment to these claims does not narrow the scope of the claims.

The Examiner states, “claims 2073 and 2112 are unclear regarding ‘substantially uniformly increasing a permeability.’” The specification states: “In the context of this patent ‘substantially uniform permeability’ means that the assessed (e.g., calculated or estimated) permeability of any selected portion in the formation does not vary by more than a factor of 10 from the assessed average permeability of such selected portion.” (Specification, page 151, lines 23-26). Applicant does not believe that the claims are unclear.

The Examiner states, “claims 2047 and 2086 are unclear regarding ‘during pyrolysis’.” Claims 2047 and 2086 have been amended for clarification. Applicant submits that the amendment to these claims does not substantially change the scope of the claims.

**F. The Claims Are Not Anticipated By Tsai et al. Pursuant To 35 U.S.C. § 102(b)**

The Examiner rejected claims 2039, 2041, 2044, 2045, 2049, 2065, 2072-2074, 2078, 2080, 2083, 2088, 2104 and 2111-2113 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 4,299,285 to Tasi et al. (hereinafter “Tsai”). Applicant respectfully disagrees with the rejection.

The standard for “anticipation” is one of fairly strict identity. To anticipate a claim of a patent, a single prior source must contain all the claimed essential elements. *Hybritech, Inc. v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 231 U.S.P.Q.81, 91 (Fed.Cir. 1986); *In re Donahue*, 766 F.2d 531, 226 U.S.P.Q. 619, 621 (Fed.Cir. 1985).

Amended claims 2039 and 2078 describe a combination of features including, but not limited to, “providing heat from one or more heaters to at least a portion of the formation.” Support for amendment to the claims is found at least in the specification as follows:

A “heater” is generally defined as any system configured to generate heat in a well or a near wellbore region. A “unit of heat sources” refers to a minimal number of heat sources that form a template that is repeated to create a pattern of heat sources within a formation. For example, a heater may generate heat by burning a fuel external to or within a formation such as surface burners, flameless distributed combustors, and natural distributed combustors, as described in embodiments herein (Specification, p. 40, lines 6-11).

Heat sources 100 may include, for example, electrical heaters such as insulated conductors, conductor-in-conduit heaters, surface burners, flameless distributed combustors, and/or natural distributed combustors. Heat sources 100 may also include other types of heaters (Specification, p. 56, lines 14-16).

Applicant submits that Tsai do not appear to teach or suggest at least the above-mentioned features, in combination with the other features of the claims. Tsai states, “the oxidizing gas is injected into the injection hole at an appropriate rate and the fire is started in the coal bed at the injection well” (Column.2, lines 30-33). Applicant respectfully submits that Tsai does not appear to teach or suggest providing heat from one or more heaters to a part of the formation.

Applicant submits that the cited art does not appear to teach the combination of features in claims 2039 and 2078 including, but not limited to, heaters. Applicant submits that claims 2039 and 2078 are allowable over the cited art.

Applicant submits that many of the claims dependent on claims 2039 and 2078 are separately patentable.

Amended claims 2041 and 2080 describe a combination of features including: “further comprising maintaining a temperature within the part of the formation within a pyrolysis



temperature range from about 270 °C to about 400 °C.” Applicant submits that the amended features of claim 2041 and 2080 are supported by Applicant’s specification on at least page 80.

The Examiner states, “the Tsai reference teaches a pyrolysis temperature range within a section of the formation (see col. 4, line 54). Applicant submits that Tsai does not appear to teach a pyrolysis temperature range in a part of the formation. Tsai appears to teach a heating air to within a range of temperatures, which may vaporize some moisture and in the coal. Tsai states,

In general, we prefer that the temperature of the heated air be a maximum of about 350 °C. and most prefer that the maximum temperature be about 300 °C. The range of about 150 °C. to about 300 °C. is a particularly suitable operating range. (Column 3, lines 41-45)

Initially, there is a vaporization of moisture from the coal and a loss of some volatile carbonaceous material. Some of this may be the result of a minor pyrolysis of the coal. (Column 4, lines 51-54).

Applicant submits that the features of claims 2041 and 2080, in combination with the features of independent claim 2039 and 2078, respectively, do not appear to be taught by Tsai.

Claims 2044, 2083, 2045 and 2084 describe the features of a flameless combustor and a natural distributed combustor. The Examiner states,

with regard to claims 2044; the Tsai reference teaches a flameless combustor (col. 2, line 32). [W]ith regards to claims 2083; the Tsai reference teaches a natural distributed combustor (col. 2., line 32).

with regard to claims 2045; the Tsai reference teaches a flameless combustor (col. 2, line 32). [W]ith regards to claims 2084; the Tsai reference teaches a natural distributed combustor (col. 2, line 32).

Applicant’s specification teaches,

Flameless combustion may be accomplished by preheating a fuel and combustion air to a temperature above an auto-ignition temperature of the mixture. The fuel and combustion air may be mixed in a heating zone to combust. In the heating

zone of the flameless combustor, a catalytic surface may be provided to lower the auto-ignition temperature of the fuel and air mixture.  
(Specification, page 4, lines 2-6)

As used herein, the phrase “natural distributed combustor” generally refers to a heater that uses an oxidant to oxidize at least a portion of the carbon in the formation to generate heat, and wherein the oxidation takes place in a vicinity proximate to a wellbore. Most of the combustion products produced in the natural distributed combustor are removed through the wellbore  
(Specification, page 40, lines 19-24).

Tsai does not appear to teach a heater such as a natural distributed combustor or a flameless combustor. Tsai appears to teach starting a fire in the coal bed. Tsai states, “the oxidizing gas is injected into the injection hole at an appropriate rate and the fire is started in the coal bed at the injection well.” (Column 2, lines 31-34).

Applicant submits that the combination of the features in claims 2044, 2083, 2045 and 2084 in combination with the feature of independent claims 2039 and 2078, respectively, do not appear to be taught by the cited art for at least the reasons cited above.

Claims 2049 and 2088 describe a combination of features including, “wherein allowing the heat to transfer from the one or more heat sources to the part of the formation comprises transferring heat substantially by conduction.”

The Examiner states,

the Tsai reference does not explicitly teach the transferring by conduction; however this is inherent in a solid substance such as coal. Even though the bulk of the heating in the Tsai method may be done by convection; it is apparent that some unfractured coal must remain, and thus the allowing heat to transfer comprises transferring heat substantially by conduction  
(Office Action, page 8).

Applicant respectfully disagrees with this rejection. Tsai appears to teach increasing permeability by fracturing the coal bed to allow the hot air to permeate the formation. Tsai states,

This link or channel between wells can be naturally occurring permeability in the coal seam involving cracks, fissures and the like. But since naturally occurring paths of suitable gas flow capacity are rare, it is generally necessary by some suitable means to significantly enhance a naturally occurring path or it may be necessary to produce an artificial path for high volume, low pressure gas flow between the injection and production wells. One solution involves the fracturing of the coal bed by injecting under substantial pressure an aqueous mixture containing suitable entrained particles as propping agents to open up fracture planes and channels in which the particles settle out to prop the fractures open when the pressure is released. Another method involves the directional drilling of one or more holes through the coal bed, generally along the bottom portion of the bed, between the injection and production holes. Other linking methods or combinations of linking methods can be used to obtain the linkage between the wells.

(Column. 2, lines 9-29)

Furthermore, Tsai appears to teach in situ combustion and gasification in an area between injection wells and production wells to produce a combustible gas from the formation. Tsai discloses:

Air is heated to a temperature of about 250° C. and is injected into the injection well at a pressure of approximately 500 psi (35.2 kg/cm<sup>2</sup>) and at a rate of about 300 ft<sup>3</sup>/min (8.5 m<sup>3</sup>/min) (standardized to one atmosphere and 15.6° C.). Injection is continued at this rate for five days. Combustion air at ambient temperature is now injected into the injection hole at a pressure of 50 psi (3.51 kg/cm<sup>2</sup>) and at a rate of 1,500 ft<sup>3</sup>/min (42.5 m<sup>3</sup>/min) (standardized to one atmosphere and 15.6° C.), and a fire is ignited in the coal at the bottom of the injection well. After the underground combustion stabilizes, a combustible product gas is obtained at the production well.

(Column 7, line 62-Column 8, line 17)

Applicant submits that it is not inherent that the invention of Tsai would conduct heat into the formation and heat the formation enough to produce a mixture from the formation. Applicant submits that portions of the aforementioned rejection appears to be set forth in facts within the personal knowledge of the Examiner. Applicant respectfully submits that the cited art does not appear to teach or suggest the features of claims 2049 and 2088 in combination with independent claim 2039 and 2078.

Amended claims 2065 and 2104 describe features including, but not limited to, “controlling a pressure within at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 bar absolute.” The Examiner states, “the Tsai reference teaches the pressure greater than 2.0 bar.”

Applicant submits that Tsai does not appear to teach controlling pressure within at least a majority of the part of the formation at least about 2.0 bar absolute. Tsai appears to teach or suggest injecting air at a pressure for approximately 500 psi or approximately 50 psi. Tsai states,

Air is heated to a temperature of about 250° C. and is injected into the injection well at a pressure of approximately 500 psi (35.2 kg/cm<sup>2</sup>) and at a rate of about 300 ft<sup>3</sup>/min (8.5 m<sup>3</sup>/min) (standardized to one atmosphere and 15.6° C.). Injection is continued at this rate for five days. Combustion air at ambient temperature is now injected into the injection hole at a pressure of 50 psi (3.51 kg/cm<sup>2</sup>) and at a rate of 1,500 ft<sup>3</sup>/min (42.5 m<sup>3</sup>/min) (standardized to one atmosphere and 15.6° C.), and a fire is ignited in the coal at the bottom of the injection well. After the underground combustion stabilizes, a combustible product gas is obtained at the production well.

(Column 7, line 62 to column 8, line 17)

Applicant submits that the features of claim 2065 and 2104, in combination with the features of independent claim 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Amended claims 2072 and 2111 describe a combination of features including, “wherein allowing the heat to transfer comprises increasing a permeability of at least a majority of the part of the formation to greater than about 100 millidarcy.” Amended claims 2072 and 2112 describe a combination of features including, “wherein allowing the heat to transfer comprises substantially uniformly increasing a permeability of at least a majority of the part of the formation.”

The Examiner states, “the Tsai reference teaches the permeability greater than about 100

md in table 1. The uniform increase in permeability is inherent.” Applicant respectfully disagrees with the rejection.

Applicant submits that Tsai does not appear to teach increasing at least a majority of the part of the formation to greater than 100 millidarcy. Applicant further submits that Tsai does not appear to teach substantially uniformly increasing a permeability of at least a majority of the part of the formation. Tsai appears to teach heating the core and recording the permeability. Tsai also does not appear to teach a substantially uniform increase in the permeability.

Tsai states, “The initial permeability of the core was 2.0, after two days it was 27.5, after three days it was 77.2 and after four days it was 107 as reported in Table I.” (Tsai, column 7, lines 11-14). Referring to TABLE I, Tsai appears to teach a permeability of 107 md for Ex. 6 and a permeability of 148 md for Ex. 7, in which the axis of the core was perpendicular to the bedding plane. Tsai does not appear to teach or suggest at least the feature of wherein allowing the heat to transfer comprises substantially uniformly increasing a permeability of a majority of the part of the formation.

Thus, Applicant submits that the features of claims 2072, 2072, 2111 and 2112, in combination with the features of independent claim 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2074 and 2113 describe a combination of features including “further comprising controlling the heat to yield greater than about 60 % by weight of condensable hydrocarbons, as measured by the Fischer Assay.” Applicant’s specification teaches, “The Fischer Assay is a standard method which involves heating a sample of a hydrocarbon containing layer to approximately 500 °C in one hour, collecting products produced from the heated sample, and quantifying the amount of products produced. (Specification, page 56 lines 5-8).

The Examiner states, “although the Tsai reference fails to explicitly disclose a Fischer Assay; it is apparent that the disclosed process will yield greater than 60%.”

Applicant submits that Tsai does not appear to teach a yield greater than 60%. Tsai appears to teach a volatile content (i.e., a yield) of 31 percent that contains greater than 84 percent carbon. Tsai states, “a volatile content of 31 percent, an ash content of 2.12 percent and a heating value of 15,200 Btu/lb (8,460 kcal/kg). Elemental analysis showed 84.73 percent carbon, 4.63 percent hydrogen, 3.1 percent oxygen and 0.59 percent sulfur. Nitrogen was not determined. (Column 6, lines 46-51).

Applicant submits that the Examiner is extending the teaching of Tsai to increase the yield from 31% to 60%. Applicant submits that the increase in yield is not inherent to Tsai. Therefore, Applicant submits that the features of claims 2074 and 2113, in combination with the features of independent claim 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art or are inherent to the cited art.

Applicant submits that portions of the aforementioned rejection appears to be set forth in facts within the personal knowledge of the Examiner. Applicant therefore believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicant requests this rejection be removed.

**G. The Claims Are Not Obvious Over Tsai Pursuant To 35 U.S.C. § 103(a)**

The Examiner rejected claims 2040, 2042, 2043, 2050-2062, 2066, 2067, 2079, 2081, 2082, 2089-2101, 2105 and 2106 under 35 U.S.C. § 103(a) as being unpatentable over Tsai. Applicant respectfully disagrees.

In order to reject a claim as obvious, the Examiner has the burden of establishing a *prima facie* case of obviousness. *In re Warner et al.*, 379 F.2d 1011, 154 USPQ 173, 177-178 (CCPA 1967). To establish a *prima facie* obviousness of a claimed invention, all the claim limitations

must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974), MPEP § 2143.03.

Amended claims 2040 and 2079 describe a combination of features including “wherein the one or more heaters comprise at least two heaters, and wherein superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons within the part of the formation.”

The Examiner states, “the Tsai reference fails to explicitly teach the superposition of heat sources. It is apparent that one of ordinary skill in the art would know that the heat sources should be spaced to substantially heat the entire formation.”

Applicant’s specification teaches,

In some embodiments, a plurality of heated portions may exist within a unit of heat sources. A unit of heat sources refers to a minimal number of heat sources that form a template that may be repeated to create a pattern of heat sources within the formation. The heat sources may be located within the formation such that superposition (overlapping) of heat produced from the heat sources is effective. For example, as illustrated in FIG. 7, transfer of heat from two or more heat sources 330 results in superposition of heat 332 to be effective within an area defined by the unit of heat sources. Superposition may also be effective within an interior of a region defined by two, three, four, five, six or more heat sources. For example, an area in which superposition of heat 332 is effective includes an area to which significant heat is transferred by two or more heat sources of the unit of heat sources. An area in which superposition of heat is effective may vary depending upon, for example, the spacings between heat sources.

(Specification, page 63, lines 8-19).

In some embodiments, superposition (e.g., overlapping) of heat from one or more heat sources may result in substantially uniform heating of a portion of a hydrocarbon containing formation. Since formations during heating will typically have temperature profiles throughout them, in the context of this patent “substantially uniform” heating means heating such that the temperatures in a majority of the section do not vary by more than 100 °C from the assessed average temperature in the majority of the selected section (volume) being treated.

(Specification, page 152, lines 7-13)

Tsai appears to teach in situ combustion and gasification in an area between injection wells and production wells to produce a combustible gas from the formation. Tsai states,

The spacing, orientation and linking of wells into a predetermined pattern for an orderly, progressive burn of the coal deposit for maximum economy in recovery of the coal's heating values is a known art.  
(Column 1, line 69 through Column 2, line 1-4).

Air is heated to a temperature of about 250° C. and is injected into the injection well at a pressure of approximately 500 psi (35.2 kg/cm<sup>2</sup>) and at a rate of about 300 ft<sup>3</sup>/min (8.5 m<sup>3</sup>/min) (standardized to one atmosphere and 15.6° C.). Injection is continued at this rate for five days. Combustion air at ambient temperature is now injected into the injection hole at a pressure of 50 psi (3.51 kg/cm<sup>2</sup>) and at a rate of 1,500 ft<sup>3</sup>/min (42.5 m<sup>3</sup>/min) (standardized to one atmosphere and 15.6° C.), and a fire is ignited in the coal at the bottom of the injection well. After the underground combustion stabilizes, a combustible product gas is obtained at the production well.  
(Column 7, line 62 to column 8, line 17)

Applicant submits that, while superposition of heat may be achieved by various heat source configurations, the Examiner is extending the teaching of Tsai by suggesting that “any configuration of heat sources that provides heat to the entire formation” would confer the unexpected advantages of superposition of heaters described above in the Applicant’s specification. Thus, Applicant submits the features of claims 2040 and 2079, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Amended claims 2042 and 2081 describe a combination of features including “wherein the one or more heaters comprise electrical heaters.” The features of claims 2042 and 2081, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2043 and 2082 describe a combination of features including “wherein the one or more heaters comprise surface burners.” The features of claims 2043 and 2082, in combination



with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Amended claims 2050 and 2089 describe a combination of features including “wherein providing heat from the one or more heaters comprises heating the part of the formation such that a thermal conductivity of at least a portion of the part of the formation is greater than about 0.5 W/(m °C).” The features of claims 2050 and 2089, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Tsai appears to teach a temperature less than the softening temperature of coal. Tsai does not appear to teach or suggest that the thermal conductivity of the part of the formation is greater than about 0.5 W/(m °C) or that uniform heating is desired. Tsai states,

Since the injection of the heated air should itself not cause the coal to swell, the maximum temperature of the injected air can be up to but not the same as the temperature at which the coal begins to soften...The range of about 150° C. to about 300° C is a particularly suitable operating range.  
(Column 3, lines 32-45).

Whether or not “a particular combination might be ‘obvious to try’ is not a legitimate test of patentability.” *Id.* at 1599, citing *In re Geiger*, 815 F.2d 868, 688, 2 USPQ2d 1276, 1278 (Fed. Cir. 1987) and *In re Goodwin*, 576 F.2d 375, 377, 198 USPQ 871, 881 (CCPA 1981). Consequently, it is not permissible for the Examiner to “use hindsight reconstruction to pick and chose among isolated disclosures in the prior art to deprecate the claimed invention.” *Id.* at 1600.

The Examiner states, “With regards to claims 2051-2062, 2066, 2067, 2090-2101, 2105 and 2106; the nature of hydrocarbons produced from such heating is highly variable and dependent upon many factors, not least of which is the characteristics of the coal.” Applicant respectfully disagrees. Applicant submits that many of the dependent claims are separately patentable in combination with the features of the independent claims.

Claims 2051 and 2090 describe a combination of features including “wherein the produced mixture comprises condensable hydrocarbons having an API gravity of at least about 25°.” Applicant specification teaches, “Condensable hydrocarbons” means the hydrocarbons that condense at 25 °C at one atmosphere absolute pressure. Condensable hydrocarbons may include a mixture of hydrocarbons having carbon numbers greater than 4.” (Specification, page 42, lines 11-13).

Tsai does not appear to teach condensable hydrocarbons having an API gravity of at least 25°. Tsai appears to teach a product gas including methane. Tsai states, “The net result is a combustible product gas comprising carbon monoxide, hydrogen and some methane as its principle combustibles.” (Column 5, lines 55-57).

Applicant submit that claims 2051 and 2090, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2052 and 2091 describe a combination of features including, “wherein the produced mixture comprises condensable hydrocarbons, and wherein about 0.1 % by weight to about 15 % by weight of the condensable hydrocarbons are olefins.” For at least the reasons cited above, Applicant submits claims 2052 and 2091, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2053 and 2092 describe a combination of features including, “wherein the produced mixture comprises non-condensable hydrocarbons, and wherein a molar ratio of ethene to ethane in the non-condensable hydrocarbons ranges from about 0.001 to about 0.15.” The features of claims 2053 and 2092, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2054 and 2093 describe a combination of features including, “wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is nitrogen.” The features of claims 2054 and 2093, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2055 and 2094 describe a combination of features including, “wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is oxygen.” The features of claims 2055 and 2094, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2056 and 2095 describe a combination of features including, “wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is sulfur.” The features of claims 2056 and 2095, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2057 and 2096 describe a combination of features including, “wherein the produced mixture comprises condensable hydrocarbons, wherein about 5 % by weight to about 30 % by weight of the condensable hydrocarbons comprise oxygen containing compounds, and wherein the oxygen containing compounds comprise phenols.” The features of claims 2057 and 2096, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2058 and 2097 describe a combination of features including, “wherein the produced mixture comprises condensable hydrocarbons, and wherein greater than about 20 % by weight of the condensable hydrocarbons are aromatic compounds.” The features of claims 2058 and 2097, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2059 and 2098 describe a combination of features including, “wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 5 % by weight of the condensable hydrocarbons comprises multi-ring aromatics with more than two rings.” The features of claims 2059 and 2098, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2060 and 2099 describe a combination of features, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 0.3 % by weight of the condensable hydrocarbons are asphaltenes.” The features of claims 2060 and 2099, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2061 and 2100 describe a combination of features including, “wherein the produced mixture comprises condensable hydrocarbons, and wherein about 5 % by weight to about 30 % by weight of the condensable hydrocarbons are cycloalkanes.” The features of claims 2061 and 2100, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Amended claims 2062 and 2101 describe a combination of features including, “wherein the produced mixture comprises a non-condensable hydrocarbons, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.” The features of claims 2062 and 2101, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2066 and 2105 describe a combination of features including, “further comprising controlling formation conditions to produce the mixture, wherein a partial pressure of H<sub>2</sub> within

the mixture is greater than about 0.5 bar.” The features of claims 2066 and 2105, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2067 and 2106 describe a combination of feature including, “wherein the partial pressure of H<sub>2</sub> within the mixture is measured when the mixture is at a production well.” The features of claims 2067 and 2106, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Applicant submits that portions of the aforementioned rejection appears to be set forth in facts within the personal knowledge of the Examiner. Applicant therefore believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant’s attention. Otherwise, Applicant requests this rejection be removed.

**H. The Claims Are Not Obvious Over Tsai In View of Elkins Pursuant To 35 U.S.C. § 103(a)**

The Examiner rejected claims 2046 and 2085 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view of U.S. Patent No. 2,734,579 to Elkins (hereinafter “Elkins”). Applicant respectfully disagrees.

Amended claims 2046 and 2085 describe a combination of features including: “controlling a pressure and a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.”

Elkins does not appear to teach or suggest controlling a pressure and a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure. Elkins appears to teach or

suggest changing the pressure and/or concentration of the injected gas pressure to control the temperature. Elkins states,

Control of the temperature within the reaction zone can be maintained in several ways. The increase in volume of oxygen-containing gas by application of higher injection gas pressure will increase this temperature. ...To keep the temperature from becoming too high, it is possible to dilute the air with inert gas, for example, by separating the inert gaseous products of combustion (principally oxides of nitrogen and carbon) from the produced hydrocarbons, and introducing it into the injection stream. ...Decreasing the injection gas pressure also decreases the combustion zone temperature.  
(Column 3, lines 26-46).

Applicant respectfully submits that the combination of features in dependent claims 2046 and 2085, in combination with the features of independent claims 2039 and 2078, respectively, do not appear to be taught or suggested by Tsai in view of Elkins.

**I. The Claims Are Not Obvious Over Tsai In View Of Kasevich et al. Pursuant To 35 U.S.C. § 103(a)**

The Examiner rejected claims 2047, 2048, 2086 and 2087 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view of U.S. Patent No. 4,457,365 to Kasevich et al. (hereinafter “Kasevich”). Applicant respectfully disagrees.

Amended claims 2047 and 2086 describes a combination of features including, but not limited to: “controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day during pyrolysis within a pyrolysis temperature range of about 270 °C to about 400 °C.”

Kasevich does not appear to teach or suggest the features of the claim. Referring to Figure 3, Kasevich appears to teach a heating rate of 50 °C/month, which may correspond to an average heating rate of about 1.6 °C/day. Kasevich states,

Thus, if the kerogen were heated from 150 °C. to 500 °C. at the rate of 50 °C./month, the absorption rate would approximate that of curve 114 [in Figure 3], while more rapid heating rates would produce curves 120, 122 and 124 for heating rates of 50 °C. per month, 50 °C./day, 50 °C./hour and 50 °C./minute, respectively.”  
(Column 8, lines 57-62).

The Examiner states, however: “It is apparent that when the temperature reaches its highest point (the point at which pyrolysis occurs) the rate of increase would be at the slowest; thus it would be less than about 1 °C/day.”

Applicant respectfully submits that the Examiner appears to be using personal knowledge to extend the teaching of Kasevich. Applicant submits that the cited art does not appear to teach or suggest the features of claim 2074 and 2086 in combination with the features of independent claims 2039 and 2078.

Amended claim 2048 and 2087 describe a combination of features including but not limited to, “wherein heating energy/day ( $P_{wr}$ ) provided to the volume is equal to or less than  $h \cdot V \cdot C_v \cdot \rho_B$ ; wherein  $\rho_B$  is an average formation bulk density, and wherein an average heating rate ( $h$ ) of the selected volume is about 10 °C/day.”

Kasevich does not appear to teach or suggest using a desired heating rate to calculate a maximum amount of heating energy/day to be applied to a selected volume of a formation. Applicant submits that Kasevich in combination with Tsai does not appear to teach or suggest the features of claims 2048 and 2087 in combination with the features of independent claims 2039 and 2078.

**J. The Claims Are Not Obvious Over Tsai In View of Stoddard et al. Pursuant To 35 U.S.C. § 103(a)**

The Examiner rejected claims 2063, 2064, 2102 and 2103 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view of U.S. Patent No. 4,463,807 to Stoddard et al. (hereinafter

“Stoddard”). Applicant respectfully disagrees.

Claims 2063 and 2064 describe a combination of features including, “wherein the produced mixture comprises ammonia, and wherein greater than about 0.05% by weight of the produced mixture is ammonia.”

Stoddard does not appear to teach a produced mixture with a ammonia concentration is greater than 0.05% by weight. Stoddard appears to teach a reaction product that includes ammonia. Stoddard states, “A seal against water incursion serves two purposes: water is excluded from the georeactor and the processes underway, and water soluble products of reactions (phenols, ammonia and the like) are excluded from the aquifer.” (Column 3, lines 28-31).

Applicant submits that Stoddard in combination with Tsai does not appear to teach or suggest the features of the claims 2063 and 2102 in combination with the features of independent claims 2039 and 2078, respectively.

Claims 2064 and 2103 describe a combination of features including, “ wherein the produced mixture comprises ammonia and wherein the ammonia is used produce fertilizer.” Applicant submits that the features of claims 2064 and 2103 in combination with the features of independent claims 2039 and 2078 respectively, are not taught by the cited art.

**K. The Claims Are Not Obvious Over Tsai In View of Gregoli et al. Pursuant To 35 U.S.C. § 103(a)**

The Examiner rejected claims 2068-2071 and 2107-2110 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view of U.S. Patent No. 6,016,867 to Gregoli et al. (hereinafter “Gregoli”). Applicant respectfully disagrees.

Claims 2068 and 2107 describe a combination of features including: “altering a pressure within the formation to inhibit production of hydrocarbons from the formation having carbon



numbers greater than about 25.”

Gregoli does not appear to teach or suggest at least the feature of “altering a pressure within the formation to inhibit production of hydrocarbons from the formation having carbon numbers greater than about 25” in combination with the other features of the claims. Gregoli appears to teach converting higher molecular-weight components into lower molecular weight component, Gregoli states,

Heavy hydrocarbons 207 in the reservoir 27 are heated by the hot injected fluids which, in the presence of hydrogen, initiate hydrovisbreaking reactions. These reactions upgrade the quality of the hydrocarbons by converting their higher molecular-weight components into lower molecular-weight components which have less density, lower viscosity, and greater mobility within the reservoir than the unconverted hydrocarbons. The hydrocarbons subjected to hydrovisbreaking reactions and additional virgin hydrocarbons flow into the perforations 203 of the casing 202 of the production-well borehole 201, propelled by the pressure of the injected fluids.

(Column 12, lines 35-46)

Applicant submits that the of features in claims 2068 and 2107, in combination with the features of independent claims 2039 and 2078, do not appear to be taught or suggested by the cited art.

Claims 2069 and 2108 describe a combination of features including: “recirculating a portion of hydrogen from the mixture into the formation.” Gregoli does not appear to teach or suggest at least the feature of “recirculating a portion of hydrogen from the mixture into the formation” in combination with the other features of the claims. Gregoli appears to teach hydrogen being fed to the downhole combustion unit. Gregoli states,

Preferably, a stoichiometric mixture of hydrogen and oxygen is initially fed to the downhole combustion unit 206 so that the sole product of combustion is superheated steam. As the reservoir becomes heated to the level necessary for the occurrence of hydrovisbreaking reactions, it is preferable that a stoichiometric excess of hydrogen be fed to the downhole combustion unit during its operation - or that hydrogen be injected into the reservoir along with superheated steam.

(Column 14, lines 28-38).

Gregoli further discloses:

The hydrocarbons subjected to the hydrovisbreaking reactions and additional virgin hydrocarbons, propelled by the pressure of the injected fluids, flow into the vertical fractures 211 of the reservoir 27 and thence into the horizontal producing wells intersecting the fractures, where they are recovered along with the injected fluids using conventional oil-field technology.

(Column 15, lines 26-33).

Applicant submits that the of features in claims 2069 and 2108, in combination with the features of independent claims 2039 and 2078, do not appear to be taught or suggested by the cited art.

Amended claims 2070 and 2109 describe a combination of features including: “providing hydrogen (H<sub>2</sub>) to the part of the formation to hydrogenate hydrocarbons within the part of the formation; and heating a portion of the part of the formation with heat from hydrogenation.” Gregoli does not appear to teach or suggest at least the features of “providing hydrogen (H<sub>2</sub>) to the part of the formation to hydrogenate hydrocarbons within the part of the formation; and heating a portion of the part of the formation with heat from hydrogenation” in combination with the other features of the claims. Gregoli appears to teach providing superheated steam. Gregoli states,

The superheated steam resulting from using partially saturated steam to absorb the heat of combustion in the combustion unit and the hot reducing gases exiting the combustion unit are then injected into the formation to provide the thermal energy and reactants required for the process.

(Column 8, lines 54-58).

Applicant submits that the combination of features in claims 2070 and 2109, in combination with the features of independent claim 2039 and 2078, for at least the reasons cited above, do not appear to be taught or suggested the cited art.

Claims 2071 and 2110 describe a combination of features including: “producing

hydrogen and condensable hydrocarbons from the formation; and hydrogenating a portion of the produced condensable hydrocarbons with at least a portion of the produced hydrogen.” The combination of features in claims 2071 and 2110, in combination with the features of independent claims 2039 and 2078, do not appear to be taught or suggested by the cited art.

**L. The Claims Are Not Obvious Over Tsai In View of Van Meurs et al. Pursuant To 35 U.S.C. § 103(a)**

The Examiner rejected claims 2075, 2076, 2114, 2115, 5396 and 5397 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view of U.S. Patent No. 4,886,118 to Van Meurs et al. (hereinafter “Van Meurs”). Applicant respectfully disagrees.

Amended claims 2075 and 2114 describes a combination of features including, “wherein at least about 7 heaters are disposed in the formation for each production well.” The features of claims 2075 and 2114, in combination with the features of the independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2076 and 2115 describe a combination of features including, “further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, and wherein the unit of heaters comprises a triangular pattern.” The features of claims 2075 and 2115, in combination with the features of the independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Amended claims 5396 and 5397 describe a combination of features including, “wherein at least about 20 heaters are disposed in the formation for each production well.” The features of claims 5396 and 5397, in combination with the features of the independent claims 2039 and 2078 do not appear to be taught or suggested by the cited art.

**M. The Claims Are Not Obvious Over Tsai In View of Van Meurs And In Further View of Salomonsson Pursuant To 35 U.S.C. § 103(a)**

The Examiner rejected claims 2077 and 2116 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view Van Meurs and in further view of U.S. Patent No. 2,914,309 to Salomonsson (hereinafter “Salomonsson”). Applicant respectfully disagrees.

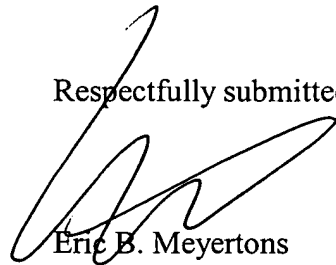
Claims 2077 and 2116 describe a combination of features including, “further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.” The features of claims 2077 and 2116, in combination with the features of the independent claims 2039 and 2078, do not appear to be taught or suggested by the cited art.

**N. Summary**

Applicant submits that all claims are in condition for allowance. Favorable consideration is respectfully requested.

Enclosed is a fee authorization for excess claims fees and the fee due for consideration of an Information Disclosures Statement. If any extension of time is needed, Applicant requests the appropriate extension of time. If any additional fees are required or if any fees are overpaid, please appropriately charge or deposit those fees to Conley, Rose & Tayon, P.C. Deposit Account Number 50-1505/5659-02200/EBM.

Respectfully submitted,



Eric B. Meyertons  
Reg. No. 34,876

Attorney for Applicant

CONLEY, ROSE & TAYON, P.C.  
P.O. BOX 398  
AUSTIN, TX 78767-0398  
(512) 703-1254 (voice)  
(512) 703-1250 (facsimile)

Date: \_\_\_\_\_

9/24/02